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Published in:

Journal of Open Innovation: Technology, Market, and Complexity

DOI:

[10.3390/JOITMC6020039](https://doi.org/10.3390/JOITMC6020039)

Published: 01/06/2020

Document Version

Publisher's final version

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Please cite the original version:

Pikkarainen, M., Hyrkäs, E., & Martin, M. (2020). Success factors of demand-driven open innovation as a policy instrument in the case of the healthcare industry. *Journal of Open Innovation: Technology, Market, and Complexity*, 6(2), [39]. <https://doi.org/10.3390/JOITMC6020039>



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Article

Success Factors of Demand-Driven Open Innovation as a Policy Instrument in the Case of the Healthcare Industry

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Received: 20 March 2020; Accepted: 13 May 2020; Published: 20 May 2020



Abstract: According to the WHO Global Digital Health Strategy 2020–2024, we should advocate people-centred health systems, promote global collaboration and strengthen the governance of global digital health practices. All this requires a new open innovation approach, which means that stakeholders from regional administrations, hospitals, companies and intermediate organisations openly work together towards commonly identified global and regional digital health goals. Although both practice and theory have proven that the open innovation approach is beneficial for companies and end-users, there is still a need for increased understanding of what leads to the success of digital health related to regional competitiveness through the implementation of policies based on people-centred open innovation. This study is a longitudinal case study in which open innovation ecosystem partners (including challengers (healthcare organisation representatives), solvers (companies), funders (policy organisations) and supporters (intermediate organisations) were monitored and analysed in three countries. The focus of the paper is to explore a digital health open innovation ecosystem over the years. The results show that the created demand-driven open innovation model can be used to strengthen the governance of digital health, and to improve communication density and knowledge transfer between the ecosystem actors. The new model is a useful way to make funding structures clearer and to improve the people centricity of digital health solutions. The findings help policy-makers to use open innovation as a policy instrument supporting hospital and company managers to increase understanding of the opportunities of demand-driven open innovation.

Keywords: open innovation; coupled innovation; success factors; innovation ecosystem

1. Introduction

There is a clear need for people-centric innovation services that are enabled by digital health practices. Such innovations should be built in to collaboration with different stakeholders such as policy-makers, experts in healthcare organisations, company representatives and intermediate organisations continuously transferring digital health knowledge. Additionally, there is an urgent need to strengthen the governance of digital health at global and regional levels [1]. In the context of this global strategy, digital health means “the field of knowledge and practice associated with the development and use of digital technologies to improve health”. Open innovation, on the other hand, means a “mode of innovation in which companies look outside their organisational boundaries in order to leverage internal and external sources of knowledge” [2]. This can be seen as a process that provides new means to continuously

transfer knowledge and improve the governance of digital health. During the past decade, there have been numerous successful initiatives in which open innovation has been shown to have a positive impact on the stakeholder companies involved [2–4]. It was highlighted by Chesbrough [2] that it would be possible for companies to improve their innovation performance by cooperating with different actors in the innovation process.

The use of open innovation is not, however, enough to fulfil the requirements of global and regional digital health policies. We also need a people-centric innovation approach, in which companies build innovations together with innovation customers and end users. This kind of people-centric open innovation approach (namely demand-driven innovation) was developed as part of the inDemand European H2020 project, which the consortium has been working on together with hospitals, companies, policy-makers and intermediate support organisations for two years to set up and test the new demand-driven open innovation model and process in policy instruments.

Although it has been shown in many cases that open innovation is key for companies' economic performance, the current literature does not provide a clear picture of the most important success factors of open innovation [5,6]. Additionally, not much attention has been paid to the success of open innovation from the perspective of various actors from different stakeholder groups who have participated in the innovation process [7–9]. Thus, there is a clear need for future research into interactive collaboration of ecosystems as spaces for innovation co-creation [10]. This study aims to increase understanding of the success factors related to demand-driven open innovation in the ecosystems, which includes actors from companies, hospitals and policy-makers. The analysis of the success factors is done from a policy perspective, which is not covered that much in the current open innovation literature. The paper is based on a longitudinal case study in which the data were collected from multiple stakeholders in the three open innovation ecosystems. The collected data include several surveys, interviews and focus group discussions that aimed to understand the success of the demand-driven open innovation process compared to the respondents' previous situations, in which they used a more closed technology push approach. In our case study, there are four key players. We have a *Challenger* that identifies needs (*challenges*) proposed by healthcare professionals. The *Funder* is a local entity that manages public funding and regional innovation activities, i.e., launching an innovation call for competition. The *Solver* is a private company that co-develops the best innovation ideas together with the *Challenger*. The *Supporter* is an intermediate organisation that delivers business support to the *Solver* and mobilises the local innovation ecosystem.

The remainder of this paper is structured as follows: Section 2 discusses open innovation in ecosystems. Section 3 explains the inDemand process and the longitudinal case study, data collection and methodology, as well as the inDemand innovation process. It also examines previous open innovation challenges and the success of demand-driven open innovation. Section 4 discusses the demand-driven innovation process as a policy instrument. Section 5 discusses the findings of the paper and the impact on policy-makers, healthcare organisations, the significance for practitioners and other impacts. Finally, Section 6 presents the conclusions of this paper.

2. Open Innovation in Ecosystems

In an ecosystemic open innovation process, knowledge flows from the company to the environment and from the environment to the company. Ecosystemic open innovation is also known as a coupled open innovation process, in which the innovation is co-created with support from different parties [11]. In practice, ecosystemic open innovation contains a network of stakeholders such as healthcare specialists, selected companies, intermediate organisations and regional funding organisations. All these stakeholders work together to create demand-driven innovations [12]. Open innovation includes phases such as learning, piloting, scaling and sustaining [13]. During this process, public and private organisations should both create, gather and share new knowledge from internal and external sources such as customers, suppliers, universities or even competitors [12,14].

Open innovation practices and activities can be classified into three different processes: inbound open innovation processes, outbound open innovation processes and coupled open innovation processes. The inbound process is characterised by knowledge flowing from the external environment towards the organisation. In the outbound process, internally developed knowledge flows towards the external environment. In the coupled process, the inbound and outbound processes are combined [11,15]. In an ecosystemic open innovation process, stakeholders work together with different partners. In these ecosystems, companies must combine the outside-in process to gain external knowledge, with the inside-out process to bring new ideas to market. To do both of these, all ecosystem partners must co-create knowledge together with others.

Open innovation intermediaries are actors that intermediate between regional governments and other organisations. This includes: knowledge exchange, co-creation techniques and participatory methods [16,17]. These organisations are necessary agents in public-driven innovation ecosystems with responsibilities for maintaining active networks and facilitating innovation orchestration. Currently, there is a limited amount of research on open innovation from the intermediaries' perspective.

The success factors linked to open innovation in ecosystems are usually seen in improvements in the company's competitive position. The most important thing about open innovation is the capacity to integrate foreign knowledge into a company's own knowledge and technology, and to externalise it [18]. During the past decade, the aim of open innovation activities in the public sector has mainly been in service performance improvements, not people-centric innovations. Additionally, the previous research into open innovation in the public sector has been limited to urban planning or general public service improvements rather than digital health and public policies [19,20].

In today's business world, the key words related to business success are people-centricity and market orientation, which makes the process of ecosystemic open innovation essential for companies. From a policy perspective, digital technologies are essential components to achieve sustainable health systems. The realisation of this potential requires that digital health initiatives are increased as part of a wider ecosystem with robust leadership, a sound financial orientation and appropriate resources [1]. In the healthcare domain, we have an urgent need for meaningful innovations [5,21–23]. The success factors for open innovation have been identified by many authors during the past decade [5,6,13,24]. In these studies, success factors have been identified from the perspective of earlier experience [5], skills and motivation [6], time to market [5], strategy [5,6], trust and compatibility [6], motivation [6], governance in the meaning of coordination [6], resources [6], facilitators [6], process management [6], leadership [6] and culture [5,6] (see Table 1).

Table 1. Success factors for open innovation.

Success Factor	Author
Previous experience	Richard, Davis, Paik, et al. [13], Panne, Beers and Kleinknecht [5]
Engagement	Richard, Davis, Paik, et al. [13]
Recruitment and resources	Durst and Stähle [6], Richard, Davis, Paik, et al. [13]
Training	Richard, Davis, Paik, et al. [13]
Communication	Panne, Beers and Kleinknecht [5]
Skills, motivation	Panne, Beers and Kleinknecht [5], Durst and Stähle [6]
Good time to market	Panne, Beers and Kleinknecht [5]
Trust and compatibility	Durst and Stähle [6]
Governance in the meaning of coordination	Durst and Stähle [6]
Facilitators	Durst and Stähle [6]
Culture	Richard, Davis, Paik, et al. [13]

In complex open-innovation projects, companies may face several types of risks and uncertainties that may also lead to failure rates. For instance, organisations must build upon initial success, plan

for subsequent engagements, recruit champions, develop training and communications and address cultural barriers [13].

3. The InDemand Process

3.1. Longitudinal Multiple Case Study

This study was carried out as a longitudinal multiple case study in which the case and focal point of the study was the inDemand EU project ecosystem, which consists of partners from Spain, Finland and France as well as 10 mirror regions in which the same process was tested [25]. A case study research approach was selected for the study because it helps researchers to understand complex phenomena. In our case, it gave us a possibility to retain the holistic and meaningful characteristics of a complex open innovation process in an ecosystemic setting. By examining multiple case studies, we are able to study a process that will be adopted in three different countries. The same study contains three single cases [26]. Our case study is longitudinal and we have examined the same case at three different points in time [26].

3.2. Data Collection and Methodology

In this case study, both qualitative and quantitative data were collected by the project partners. The data collection was done by using a mixed methods approach in which quantitative and qualitative methods are viewed as complementary data collecting methods [27,28]. During the validation, both qualitative and quantitative data were collected by the project partners using the detailed guidelines. Data collection followed the method of participatory action research [29], in which researchers of the inDemand model actively participated and observed the execution of the inDemand model in real time.

The data for this study were collected in three phases in parallel with the new open innovation model piloting and promotion (Table 2). The data collection steps were: 1) expectation-based questionnaires; 2) short questionnaires during mock-up and prototype presentation meetings; 3) co-creation interviews; and 4) focus group interviews. In conclusion, the data for this study included 33 expectation surveys, 47 co-creation surveys, 22 interviews and five stakeholders focus group workshops that were collected in a longitudinal manner over a two-year time period.

Table 2. Data collection in the inDemand project.

Data Collection	Source	Iteration
16 company representatives	Expectation surveys	Co-creation iteration 1
11 hospital representatives		
6 intermediate organisations		
11 company representatives	Individual interviews	Co-creation iteration 1
11 hospital representatives		
3 hospital representatives, 3 intermediate organisations, 3 policy-makers	Focus group interviews	Co-creation iteration 1
26 hospital representatives, 14 companies, 3 policy-makers, 4 intermediate organisations	Co-creation surveys	Co-creation iteration 1
14 companies, 23 hospital representatives, 4 policy-makers, 4 intermediate organisations	Expectation surveys	Co-creation iteration 2
18 hospital representatives, 13 companies, 1 policy-maker, 4 intermediate organisations	Co-Creation survey	Co-creation iteration 2

3.3. InDemand Open Innovation Process

The units of analysis for our study are 10 open innovation cases that were conducted during the inDemand EU project in France, Spain and Finland between 2017 and 2019. The aim of the inDemand project is to create and empirically test a new needs-driven open innovation approach in which the challenges for the innovations are identified and evaluated by specialists. In the inDemand consortium, healthcare organisations (Challengers) and companies (Solvers) innovate and co-create digital health solutions with the business support provided by the intermediate organisations (Supporters). This process was funded by the H2020 project in which the funds were managed by regional policy-makers, i.e., regional funding organisations (Funders) (see Figure 1).

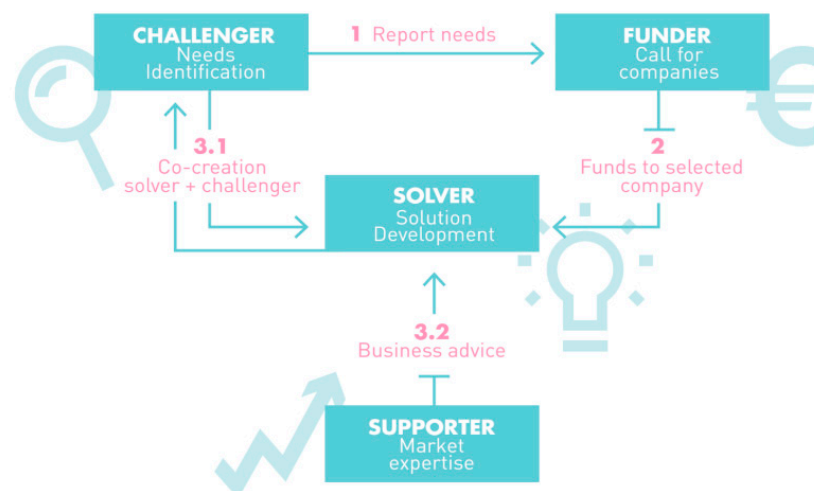


Figure 1. The inDemand model [25].

The demand-driven open innovation in our project started with challenge identification, which was carried out by clinical experts in the hospital organisations. This was conducted by the *Challengers*, who launched a specific *Call for Challenge* in the selected hospitals in order to gather challenges related to the innovation needs in the hospital context. It was realised during the open innovation process that it was important to consider the regional differences and to be flexible when defining selection criteria, topics, questionnaires and tools to collect the challenge information for future innovations. For instance, in Finland, the first inDemand *Call for Challenges* was linked to the overall hospital strategy, particularly the renewal of a new women's and children's hospital building, whereas in France, the French *Challenger* was not a hospital like it was in the other regions, but a central public purchasing body specialised in the healthcare sector. Therefore, the *Challenger* worked in collaboration with one private hospital in Paris to identify unmet needs and define the challenges for the region. For the first iteration, the French *Challenger* decided to test the inDemand model with just one hospital, in which they decided not to have a specific topic for the first challenge iteration, to test the flexibility of the inDemand model (see Table 3).

After the challenge selection, the local funder organisations in each country launched a public call for companies for the selected *Challenges*. Each funder received a financial contribution from the European Commission, which was intended for the selected *Solvers* for each *Challenge* in two iterations. The process for the call for companies started with a set-up, call publication and information dissemination, and then continued with the evaluation and granting, finally ending up with results notification and *Solver* interaction. The received company applications were evaluated using pre-identified criteria that had been selected in several meetings together with the innovation actors. The selected criteria for the *Solver* selection included the innovation potential, alignment of the solution with the need, technological viability and cost effectiveness, credibility of the proposed work plan, co-creation and

motivation, experience and skills set of the team, as well as the go-to market strategy, effectiveness of implementation and business commitment (see Figure 2).

Table 3. Challenges selected for further co-creation (Iteration 1).

Region	Selected Challenges
Spain	
Challenge 1	Need to reduce the risk of patients requiring re-entry to the Intensive Care Unit (ICU)
Challenge 2	Need for a new intervention for children and families addressing education, motivation and adherence
Challenge 3	Need for better patient-doctor communication for epilepsy management
Challenge 4	Need to develop an online platform in the planning, monitoring and evaluation of healthcare education
Finland	
Challenge 5	Need for room resource planning support
Challenge 6	Better remote control for children's asthma examinations
Challenge 7	Better breastfeeding guidance between the hospital and the mother and child clinic
Challenge 8	Need for electronic communication in the case of paediatric and adolescent diabetes care
France	
Challenge 9	Optimisation of continuous monitoring of stroke patients in neuro-vascular units
Challenge 10	Need for remote monitoring of real-life patient data to anticipate complications in health status

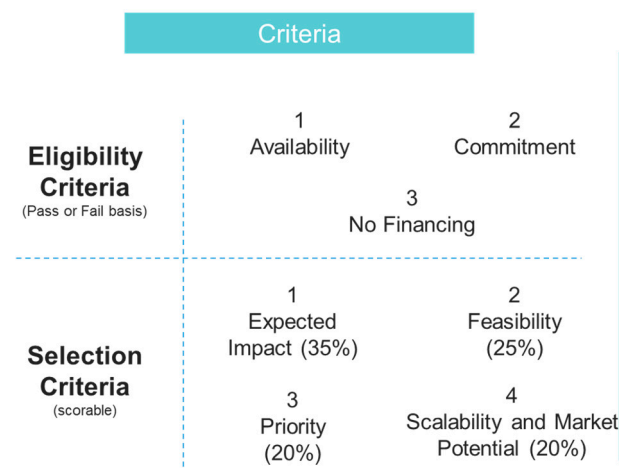


Figure 2. Selection criteria.

3.4. Previous Challenges of Open Innovation

After the company selection, kick-off meetings in the *Challenger* organisations were held with the selected *Solver* company teams to gain a common understanding of the designed coupled open innovation methodology, including co-creation work plans. In this phase, the selected companies and hospital representatives were informed about the number and form of the interactions, milestones, expected results and key performance indicators (KPIs) to measure the impact of the developed solutions. As a minimum, two face-to-face meetings were agreed in each region between the hospital representatives and each company, where two prototypes were presented. At these meetings, hospital teams evaluated the compliance of the prototypes with the requirements defined and made suggestions for improvements. Once the second prototype was presented and validated, the companies presented a training plan for users in the hospital to get started on how to work with the solution [30].

Before the co-creation phase, all 10 selected companies received a survey in which we asked what kinds of problems they had faced before carrying out innovation actions with the hospitals or health service providers (see Figure 3).

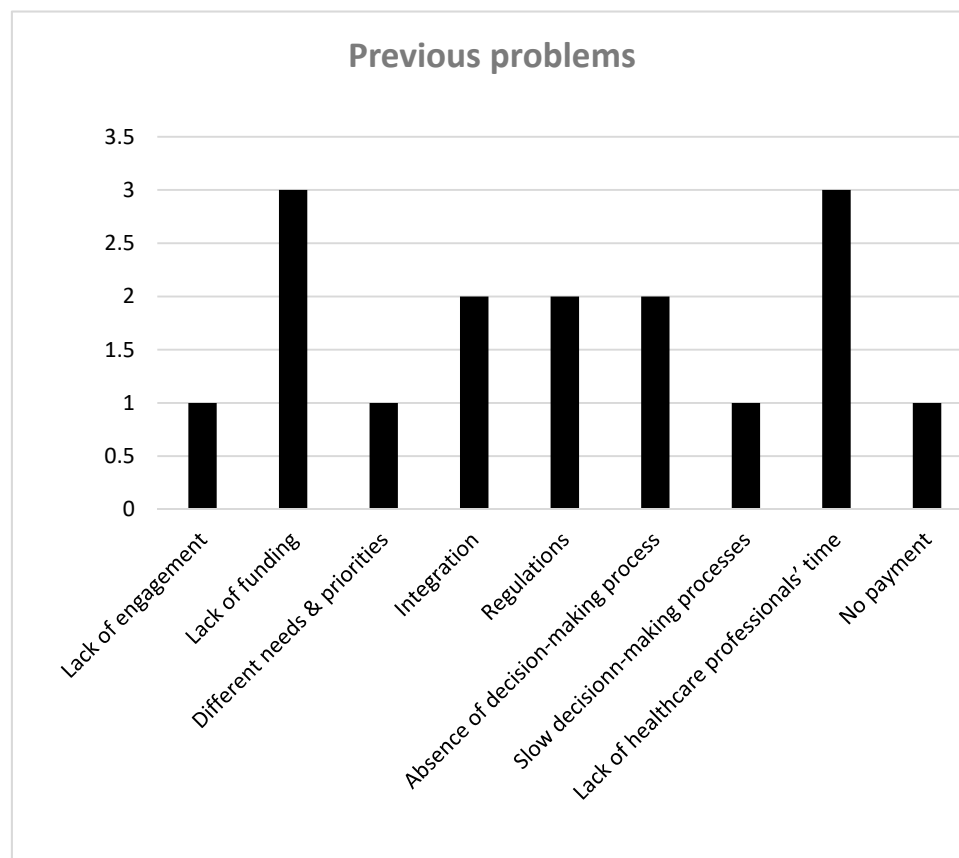


Figure 3. Previous company challenges related to the hospital innovation.

The problems that the companies mentioned in the survey were lack of healthcare or IT expert engagement, lack of funding for co-creation, different needs and priorities, problems with the solution integration into the hospital systems, difficulties in terms of regulations, absence of or slow decision-making as well as healthcare professionals' lack of time and no sales after the innovation projects.

3.5. Success of Demand-Driven Open Innovation

This section presents and discusses the success factors of the project. It is illustrated with quotations from the surveys.

It became evident in our analysis that it was important to find highly **motivated** hospital leaders for the open innovation co-creation. From the *Solvers'* perspective, some of the interviewees stated the following:

"The most important thing is to find 'motivated' leaders for the challenges".

"We noted that the challengers are still very motivated to use the tool, which was ultimately proposed by them".

The companies also felt that the feedback they received from the hospital representatives and patients motivated them in their work. The following quotation illustrates these sentiments: *"We are very motivated by the feedback we receive ...especially from the patients, which, as we saw, even made schedules for us".*

Many of the participating companies were also very grateful for the fact that the feedback received from end-users actually helped them to focus their work efforts on the right activities. As one of the interviewees explained: *"When the product development was done, we and the customer got the feeling that this is a good thing, then it succeeded".*

Challengers at the hospitals were very motivated to carry out open innovation in all of the participating countries, but the level of motivation increased during the co-creation phase when the participants started to see prototypes of the solution that they had originally ideated. This was explained by one of the interviewees as follows: *“The motivation probably increased as the project advanced. When the project got up and running and the ideas were ready, we would have probably been able to generate new ideas, because at that point we understood the process better”*.

In Spain, the high level of motivation had a positive impact on the way the people used their time and participated in the project activities. However, there was some criticism concerning the need to hire extra staff. This was explained by one of the interviewees: *“The team was motivated, worked in the evenings, even in the middle of summer, and because everyone was motivated and wanted this to go ahead, everything went smoothly, but if they hired people for this and worked in the mornings, this could be done a lot better”* (Challenger, Spain).

In France, the *Challengers* were initially enthusiastic about the innovation activities but the motivation decreased over the time. The following quotation illustrates this aspect: *“We had initial enthusiasm, then bumps and a bit of, not disappointment but exhaustion”*. Overall, the *Funders* commented that the inDemand approach with the careful company selection was beneficial for the regional ecosystem development. However, there were cases in which the Funder decided not to take a company on in the co-creation process because they had a lack of motivation. The following quotation explains this aspect: *“They just, they were so sure that they were really good that they answered, each time, for each section in the application form they just put one sentence. They didn’t want to explain why they were really good. So in the end we were, we thought that they were not motivated enough”*.

The most important skills and capabilities that the companies got from demand-driven, open innovation were networking skills with ecosystem players. It was mentioned that the process increased the interaction between hospitals and companies, making it possible to build the relationships at a very deep level. This aspect is explained in the following quotations:

“This kind of interaction in a completely new role has been very educational and really different”.

“We’ve learnt how to co-create formally, with a formal collaborative framework and now, if we collaborate with others, it would be simpler; we would know what to ask for better”.

Additionally, it was mentioned in the interviews that it was very important for all the players to have clear information on the collaboration rules of the open innovation process. This was noted in the following quotation: *“In the beginning, at the co-creation meetings, not all members had experience of the co-creation process, which made the assumption of roles difficult. People either waited, or they didn’t know, since we didn’t know exactly what each one would do, and we didn’t have enough knowledge about the co-creation rules”*.

For *Challengers* in Spain and France, the collaboration with technology companies was identified as a learning process that improved their knowledge about the technology possibilities. One of the interviewees explained this by saying: *“The world of new technologies is exciting and leads to a series of situations that we’re not used to in the healthcare world”*. It was shown in France that the hospital representatives often thought that the technological solution development would be more difficult than it actually was: *“It teaches us that things we think may not be possible can be achieved in a technical way, because we don’t necessarily have the knowledge of the technical development stage for some tools”*. In Finland, the *Challengers* also learned what kinds of skills the other people had at the same hospital. One of the interviewees explained this as follows: *“I have acquired a better understanding of people’s skills in different fields. It has never been under question whether they are skilled at different things but, in a hospital, if you think about clinical work or research, there are specific competency areas and activities, and it’s always really refreshing to learn about other areas that you haven’t even thought about in terms of how they work and what kinds of experts there are”*.

The role of facilitators, i.e., *Supporters*, was evaluated as highly important for the success of the open innovation. One of the interviewees noted: *“The business support that you gave us was very good,*

because you gave us many guidelines that perhaps we didn't even know". It was noted, however, that it was important for companies to adopt an active role towards their *Supporters* and ask questions and seek support whenever needed: *"I've felt positive about this project all the time in the sense that, as long as I was smart enough to ask, I got at least some kind of support"*. The *Supporters* themselves commented that the company coaching and mentoring was actually difficult to do following the initially identified plan; so the supporters had to take a new tailor-made approach to the business support activities during the co-creation project. Indeed, the companies were at different phases of their business life cycles with very different needs and different solutions requiring field-specific knowledge. This was explained by one of the interviewees: *"Companies are quite motivated, but they are looking more at the network, for opinion leaders and future clients. The needs are really different"*.

Some of the *Funders* commented that it was surprisingly difficult to find really good companies to solve hospital challenges. One interviewee noted: *"Some companies that we thought were really good did not answer the call. Sometimes the grant was not high enough to keep the companies motivated for the co-creation phase. We found one company that we did not want to keep. They were really good but ... not really motivated because they did not receive 100% of the funding"*.

Both *Challengers* and *Solvers* evaluated that the funder's involvement in open innovation was clearly one of the major success factors for demand-driven open innovation. The following quotations express this view: *"Everything was organised and we didn't have to worry about it ... there was a person dedicated to it, to do it, we would like that"*. *"The funder has helped us a lot... They made it possible that we could carry out developments, accelerate implementation and create a solution"*.

One *Funder* also thought that working on the *inDemand* project had been a good approach for cooperation in the regional ecosystem: *"But, so yes, (I just see that some), I haven't collaborated with (-) the challenger and the supporter before, and, so yes, the thing for me is that collaboration can emerge very quickly and we should help this collaboration to emerge. ... even in the region, this model helps the institutions to work together. That's a very good thing"*.

Time to market: It was shown that the coupled open innovation, which was based on the hospital needs and systematic co-creation process and actions, can actually have a positive impact on the time to market for the involved companies. One of the interviewees explained this: *"We could actually say that developing a solution via the inDemand process speeds up putting it on the market"*. In practice, *inDemand* helped companies to develop solutions that they could later offer to their customers. This is explained in the following quotation: *"Of course, when we go to market, we can offer something which is already defined, because these months have been like a condensation of perhaps many more months of development or because we've concentrated knowledge and technology and this has allowed us to advance quickly on all levels"*.

Player compatibility: Open innovation that occurred in the *inDemand* consortium was evaluated as an efficient way to bring together a team of multidisciplinary people so that each person in the team could contribute to the open innovation with their own knowledge *"without restricting the knowledge to the company, but to open it up to other people, to other companies, to other entities and to support each other"*.

Coordination/Governance: All stakeholders (namely policy-makers, companies and hospital representatives as well as support organisations) were very satisfied with the clear roles and responsibilities identified in the *inDemand* open innovation process and the way it was coordinated. This was explained by one of the interviewees from Finland: *"I think it has been managed well. Regarding scheduling, the communication has been a little one-sided. When scheduling these meetings or innovation appointments it worked well"*. In France, however, it was mentioned that challenges and priorities should have been better identified for the project, which could have sped up the start of the French development.

The *Funders* were satisfied with the new model and how it has been implemented so far. One of them noted: *"I think the response at the end will be positive, since in the mid-term we are positive about the implementation, and possibly some positive experimentation. That's it. But, as far as the call and co-creation has been, the outcome has been even better than I expected"*. The project has been a new way of generating innovations from the demand-driven perspective. In the past, innovation work between companies and hospitals was done more from the technology push perspective. One of the

interviewees explained: “We have never identified any demand-driven innovation so far, so we are doing this for the very first time and one of the positive results of inDemand is to put the emphasis not only on the offer side but also on the demand side”.

Resource allocation and schedule planning were identified as extremely important for the success of open innovation co-creation. This was explained in the following quotation: *“Having enough time is also important at the level of co-creation, I think it’s important to analyse each of the challenges, in each of the needs, the established timing”*. Thus, it is critical for open innovation success to make enough time for co-creation discussions. This was further explained: *“We had to advance the development a lot and devote a lot of resources, always rushing...until an end user arrived, a patient, who said that they had waited for years to have a tool, and it’s not worth having one by rushing now”*.

Companies also criticised the fact that the healthcare professionals did not have always time to focus on their issues due to some emergency tasks that they had to do as a part of their daily work. Therefore, it is important to be flexible in terms of open innovation activities and the timing in these special case situations. As one of the interviewees explained: *“It’s a problem in health care that the professionals don’t have time. Then they have to try to carry out some kind of innovation activity alongside their other work, which doesn’t really help them at that moment at all. We saw that in the testing phase, when there were lots of people from where the intention was to do the testing. It happened to be a terrible crisis day, and there were some doctors and nurses present”*.

Six of the eight *Challengers* stated that they had difficulties allocating the time for the innovation activities. For instance, one *Challenger* from Finland explained: *“We are a hundred per cent engaged in clinical work. Patients come, we have appointments, we can’t appoint one person to work on such a project full-time. It would be good if we could, but we can’t”*. Another mentioned, *“We have seen the main problems related to time, time that you have to dedicate outside of your work schedule, that has been the main problem”*. Many stakeholders also commented that they would have liked to do much more and to give more comprehensive feedback to the participating companies. In this vein, one of the interviewees stated: *“I think we could get more out of it if we had more time with the health professional to work with the company and not look for a gap outside of working hours, having to reconcile other things in order to dedicate time to this”*.

Communication density: It was noted that the demand-driven open innovation helped *Solver* companies to go into more depth with the conception as well as to create a stronger bond with the hospital representatives. The following quotations explain this aspect: *“During the inDemand project we have gone much further in co-conception with the patients and doctors in our solution”*. *“We created a much stronger bond, because in the end we were there for them and with them to develop something in common”*. It was stated that it was important for the success of the open innovation process that the hospital representatives had time to give sufficiently in-depth feedback for the company related to the developed solution. This was described by one of the interviewees: *“There is some content that was their responsibility and we believe that it should have been elaborated in greater depth and in a better way”*.

In all countries, the *Challengers* were generally satisfied with the density of the interaction, but at the same time it was mentioned in the interviews that working more closely with companies would have led to better performance. In Finland, it was revealed that the *“shared meetings were the most important channel for the collaboration”* and since the work happened in the same places within the hospital, it was physically easy for hospital representatives to attend meetings. In Spain, the communication happened every two weeks or through video conferences and via the Slack communication platform, but representatives commented that they would have like to have more face-to-face meetings with company representatives.

Solution relevancy: The demand-driven open innovation, in our case, was evaluated to be an excellent and sometimes the only way to increase solution relevancy from the end-use’s perspective. This was expressed clearly by the interviewees: *“We are in contact with specialists in this disease who tell us their needs and what could be useful for them. In addition, patients are also end-users, they are the ones who tell us if they like the tool or not, and if it’s useful for their daily life or not and we wouldn’t be able to contact*

with them in other ways [. . .] if you don't have co-creation and testing opportunities, the product will easily remain very far from the end-user".

This was the case even if the companies had people with a medical background. As one of the interviewees put it: "Even though my background is in medicine and I struggle with exactly the same things as the service organisation all the time, still the goals and desires may differ from my assumptions". In some cases, the coupled open innovation process conducted in the inDemand project clearly helped companies to prioritise the right features to be implemented into their solutions. This was mentioned in the interviews: "There's a huge amount of work to do there. It's important to us that we get the genuine needs and problems under discussion, and they come up during a meeting".

It was shown in the analysis that demand-driven open innovation was seen by the participants as successful because it was not a technology push approach in which the companies just provide ideas and then test them with health professionals to see whether they are applicable or not. This was explained by one interviewee: "*inDemand has allowed us to start from our needs, from what we live on a daily basis*". "*We were able to test it in a concrete way, we had a very good spirit...from the patients' side, they are concerned with the practicalities of communication*". Three of the 10 cases did not meet the challenged expectations. For instance, in France, the selected ideas were too big to be implemented in the proposed timeframe. Therefore, one of the interviewees noted that "*there are always gaps or development requests being made*" which "*add to the difficulties around functionality that we wouldn't foresee until we actually tested the tool*". In these cases, it was decided to continue the co-creation efforts between the companies and hospital representatives after the six-month co-creation iteration.

4. Demand-Driven Innovation Process as a Policy Instrument

Table 4 summarises the success factors for people-centric open innovation against the success factors presented by Panne, Beers and Kleinknecht [5] and Durst and Stähle [6], and three elements of digital health policy presented by the WHO [1].

Table 4. Success factors (modified based on Panne, Beers and Kleinknecht [5,6] of demand-driven open innovation compared to the global digital health policy.

Policy Goal 1: People-Centred Health	
Motivation	Companies very motivated due to the great feedback from hospitals
	Hospital personnel better engaged with the innovation
Solution relevancy	Better solution relevancy due to the continuous hospital feedback
Time to market	References from hospitals speed up the involved companies' access to the market
Policy Goal 2: Strengthen the Governance of Digital Health	
Governance	Efficient way to bring together a team of multidisciplinary people so that each person in the team contributes with their own knowledge
	All parties very satisfied with the systemic model; clear roles and responsibilities
Provision of resources	Hospital personnel had difficulties allocating the time for innovation activities, which had a negative impact on the project performance
Facilitators	Intermediate organisations ensure that companies transfer the lessons learnt from the co-creation into a new business model to meet the needs of the target market. Funders lower the threshold for companies to take part in open innovation projects.
Solution relevancy	The demand-driven innovation process was an efficient way to stimulate the digital health service development and to continuously test the solutions
Strategy	The work should be aligned with company, hospital and regional strategy -> supporters' and funders' roles were considered important
Skills	The demand-driven innovation process increased the networking skills of the involved ecosystem players
Policy Goal 3: Promote Global Collaboration and Knowledge Transfer in Digital Health	
Governance	An efficient way to bring together a team of multidisciplinary people so that each person in the team contributes with their own knowledge
Solution relevancy	It was shown that the demand-driven innovation process resulted in better outcomes than initially expected

According to the WHO [1], the policy-level goal for digital health is to advocate people-centric health systems that are enabled by digital health. This means that digital health technologies should be deployed and used so that they scale up and strengthen health services. In the WHO [1] report, the first aim of digital health policy is to provide services that support patients, families, communities and health workers. The results of this study related to the solution relevancy is adding new perspective to the literature review and research agenda suggested by Thunee and Mina [31] who argue that the strong involvement of hospital experts in co-creation is beneficial for solution novelty and innovativeness. It was shown in our case that involving funders and intermediate organisations in open innovation was an influential step in answer to the funding problems and difficulties that the companies working in the healthcare market had previously faced. Compared to the companies' previous experiences, the inDemand model made the needs and priorities clearer for participating companies, helping them to focus on the people perspective in their development efforts and therefore gain references that helped them to speed up solution deployment in the digital health market. This indicates that the demand-driven open innovation model can also be used to provide solutions that are more relevant to end-users and, thus, more relevant to the target market.

The second policy-level goal for digital health is to strengthen governance, i.e., the capabilities and skills of the countries and regions to promote innovative digital health technologies. This is done, for instance, by sharing best practices and promoting required standards within and outside the health sector and addressing the need to stimulate the development and testing of new technologies, methods and infrastructures [1]. At the same time, as the new way to do value creation creates new competitive space for firms, there is a need to invest in developing new functional and governance capabilities that are associated with high-quality customer-company interactions and personalised co-creation [32]. In our case, it was noted that changing the process from traditional innovation towards a demand-driven innovation process and identifying the best practices was a major effort for all the participants in the inDemand consortium, and arguably it could not have been achieved without systematic and clear role and process identification and great leadership and coordination. Employees, however, need to have the capability to innovate in both companies and healthcare organisations. Additionally, this innovation capability improvement should be strongly supported by each involved organisation. Cultural and process changes are difficult without these two elements.

In our case, the new process also increased the networking skills of the involved ecosystem players. From a governance perspective, the predefined schedule, process and communication tools helped to find suitable ways and times for the different parties to talk together, but they could have been more flexible in the case of more demanding challenges or when critical patient situations suddenly took up more time than originally planned from health professionals. It was shown in our case that in the demand-driven innovation process, identifying the challenges in hospitals was an important step towards more motivation and engagement with hospital specialists.

The existing research indicates that users might not be appropriate sources of innovation due to the lack of technical expertise and problem-solving capabilities [33]. In our case, it became evident that the end-users are very valuable sources of innovation, since it helps to continuously stimulate digital health service development and to test solutions in a very concrete way. The third policy-level objective for digital health is to motivate different stakeholders to take advantage of global opportunities, meet challenges and use digital technologies to improve citizen health. This can be achieved by sharing digital health knowledge across different domains. In this policy strategy, health technologies are seen as an important way to create new health services and thus to assure high-quality health outcomes. The demand-driven open innovation process was shown to be an efficient way to set common targets and to bring together a team of multidisciplinary people so that each person in the team contributes with their own knowledge. This resulted in better health outcomes than the policy-makers expected at the beginning.

5. Discussion: The Relation between Open Innovation Success Factors and Different Stakeholders

5.1. Impact on Policy-Makers

Improving the cost efficiency of hospital care is a key goal of health policy in many countries [34]. This research on the success of demand-driven open innovation is significant for policy-makers in the sense that it provides evidence of a working process model between public and private actors that can be used to improve policy-level goals for global digital health. In fact, during the inDemand project we involved several mirror regions (i.e., other hospitals and areas), in which the inDemand model has already been tested. Shedding light on new ways to carry out successful open innovation in an ecosystemic context between the policy-makers, companies and healthcare specialists is a starting point to create a sustainable open innovation process model that can be used to improve collaboration in the other sectors, in which private and public players need to work openly together to co-create user-centric innovations. Yun, Won and Park [35] have presented entrepreneurial cyclical dynamics of open innovation and it is shown a kind of concept model of the dynamics of the modern economic. They expanded the open innovation concept to an economy model; open innovation is a new combination between technology and the market or society. This kind of innovation is not only about quantitative growth, but it also increases the social innovation. The new demand-driven innovation model can also be seen as an enhancing instrument to create and further develop regional innovation ecosystems.

There are also some other empirical studies focused on regional healthcare ecosystems looking at knowledge flows between different players, such as policy-makers who are often involved in innovation activities as medium-level opinion leaders [36]. As the regions in our study define the roles of *Challenger*, *Funder* and *Supporter* and co-create new solutions with companies during a structured co-creation process, they identify the required research, development and innovation activities together in the regional innovation ecosystems. As a result, regions are able to offer companies environments to develop new solutions from ideation to final product launches. In this context, companies are offered a unique value creation process that will help them to meet the needs of different target markets. In this situation, regions used innovation ecosystems for setting common targets for the regions, thus acting as a platform for a jointly defined (digital health) strategy.

5.2. Impact on Healthcare Organisations

It has been argued in previous research that firms should actively identify or search for external sources of innovation by collaborating with many external stakeholders or collaborating with specialists [37]. Yun and Liu [38] have proposed a conceptual framework to understand open innovation micro- and macro-dynamics with a quadruple-helix model for social, environmental, economic, cultural, policy, and knowledge sustainability. According Yun and Liu [38] open innovation requires co-creation and collaboration between different stakeholders to motivate open innovation micro- and macro dynamics. It became evident in our study that the demand-driven open innovation model can also be highly valuable to participating hospitals. It was shown that the new demand-driven open innovation process can be used to ensure motivation of the clinical personnel in the innovation activities in private and public hospitals. Additionally, the new process model can be used to increase the knowledge of technological opportunities among clinical personnel. This is contrary to the previous study by Sahrish and Halim [39], who argued that open innovation practices currently in use in services firms cannot be used in hospitals because the services delivered in hospitals are unique and very personally linked to individuals. According to the involved policy-makers in our project, the next step for the ecosystem would be to carry out randomised controlled trials to get scientific evidence of the developed solution impacts on hospitals and patients.

5.3. Significance for Practitioners

Naturally, the study also brings additional value to any companies who are planning or doing innovation activities in the healthcare market. In this domain, the companies need to work on a constantly changing ecosystem that is also affecting the value proposition of the co-created innovations [40]. In our study, it became evident that doing co-creation in an open innovation context with ecosystem actors helps companies to focus their efforts on the right things. In our study, supporters have received feedback from solver companies who have been saying that one of the biggest values is that healthcare professionals are able to state from the beginning what their needs are so that they do not have to do any guesswork.

5.4. Impact on Other Sectors

Although demand-driven open innovation in our case started in the health and e-health sector, it is worth replicating it in other sectors such as the energy and environment sector, in which private and public actors need to engage in continuous collaboration in the ecosystems to ensure the sustainability of technology innovations. Klijnand Teisman [41] have defined the characteristics of public-private partnerships, including: cooperation, durable relationships, developing mutual products/services, sharing risks, costs and benefits, and mutual value addition. Public-private partnerships (PPPs) could be defined as cooperation between public and private actors with a sustainable nature in which actors develop mutual products and/or services and in which risk, costs and benefits are shared. Public and private organisations could use PPP as a form of co-production. The added value of synergy is important; for example, being able to develop products with characteristics that are a result of PPP [41]. Demand-driven open innovation is important in the all service business. Yun, Park, Gaudio, et al. [42] have investigated open innovation ecosystems of four successful restaurants in three countries. According to this study open innovation is important to the sustainable development of any restaurant. The role of the customer is very important in the service business such as restaurants for example.

6. Conclusions

There is an increasing need for individual centrality of innovation in ecosystems in which the innovations are co-created together with different stakeholders such as policy-makers, experts, company representatives and intermediate organisations. However, there is little research about interactive collaboration and innovation co-creation in digital health ecosystems.

The aim of this paper was to explore the success factors of demand-driven open innovation as a policy instrument. This was done using a longitudinal case study in which data were analysed from three different countries that all used a similar demand-driven open innovation process model. This involved a total of 10 different innovation co-creation cases. Based on the analysis it became evident that the created demand-driven open innovation model can be used to improve global digital health policies, achieving better people centrality through hospital personnel engagement and promoting knowledge transfer in digital health through higher communication density between the ecosystem actors. The new innovation model is a useful way to strengthen the governance of digital health by making process roles, responsibilities and funding structures clearer to all the participating stakeholders. The model also facilitates and speeds up customer relevance as well as time to market of the results.

The limitations of these findings are related to the empirical case study research approach. Its scope, which was the study of the innovation co-creation success factors, has only been based on one project data set and thus more research is needed to gain more empirical evidence about the process and result relevancy and sustainability. However, the aim of this paper was not to comprehensively describe what demand-driven co-creation is or how to make it work in a sustainable manner, but rather to point out what the key success factors are that policy-makers should take into account when using demand-driven open innovation as a policy instrument.

Author Contributions: E.H. provided first draft of the paper. M.P. modified the theory part, made empirical analysis. Both authors jointly worked with the review comments. M.M., made the research possible in Indemand project. She also reviewed the paper and provided valuable additions and editing related to the scope and focus of the paper. All authors have read and agreed to the published version of the manuscript.

Funding: This project was funded by European Union's H2020 Programme, SC6-CO-CREATION inDemand

Acknowledgments: We thank the European Commission for the inDemand project funding from the European Union's H2020 Programme, SC6-CO-CREATION-2016-3, for research, technological development, and demonstration (Grant Agreement no 763735). We thank the inDemand Consortium members for taking part in the data collection in the pilot regions and Heini Malm, Mikko Väisänen and Romain Vallée for helpful comments in the finalization of this paper.

Conflicts of Interest: The funders of the project had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

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